

amendments and remarks herein avoid and/or traverse both of the Examiner's rejections.

Paragraph 0012 of the Specification is herein amended to correct a minor typographical error.

Applicants have herein amended Claims 15, 21 and 23 and cancelled Claims 22 and 24 to avoid the rejection over Chau et al. Support for these amendments will be found throughout the Specification, and particularly in Paragraph 0011.

Chau et al. disclose acid treatment of a wet membrane with wide variety of organic and inorganic acids, almost all of which are entirely unrelated to Applicant's invention and in fact will not work in Applicant's invention. Chau et al. disclose only two specific sulfonic acids, neither of which is a C₁-C₆ sulfonic acid (col. 7, lines 8-9). Both are solids at the temperatures of coating of Applicant's membranes and therefore inoperative with respect to Applicant's invention. Applicant's amendments herein limit the sulfonic acids with which the membranes are coated in Applicant's invention to low (C₁-C₆) molecular weight sulfonic acids which are liquid at the applicable coating temperature, such as the exemplified methanesulfonic acid (¶ 0011). As so limited, the claimed sulfonic acids are not disclosed by Chau et al. and therefore Chau et al. does not anticipate the claimed invention under § 102(b).

In repeating his rejection based on Cadotte et al. in view of Koo et al., the Examiner acknowledges that Cadotte et al. teaches only "strong" mineral acids and does not involve sulfonic acids of any type. He contends, however, that since Koo et al. teaches that many acids, including sulfonic acids, are "strong" acids, they must all be interchangeable. From that he takes the step that it would be obvious to substitute a sulfonic acid for a mineral acid in the Cadotte et al. system. Such a contention is entirely unwarranted.

If Cadotte et al. had meant *only* "strong" acid instead of "strong *mineral*" acid the patentees would have said so, in the same manner that Koo et al. names both strong mineral and organic acids. The fact that Cadotte et al. repeatedly limit their invention to strong *mineral* acids makes clear that one skilled in the art would understand that substitution of an organic acid, even one which might be considered "strong," is *not* within

the scope of the Cadotte et al. disclosure. The Examiner might have been justified in his rejection if Cadotte et al. were silent on the issue, but they are not. A rejection cannot be made by combining two references which are directly contradictory to each other.

Further reason exists for not combining Cadotte et al. and Koo et al., particularly with respect to the amended claims. As Applicant described the previous Response in this case, Cadotte et al. disclose a two-step system in which the membrane must remain in contact with the mineral acid in the aqueous phase, as illustrated in the following Table 1:

TABLE 1
Primary Claim of Cadotte et al. 4,765,897

	Membrane Description	Acid Treatment Step	Film Repair Step
'897 Cl. 1	A membrane useful for water softening which is prepared by a process comprising	(a) contacting a crosslinked polyamide discriminating layer of a reverse osmosis membrane with an aqueous solution of a STRONG MINERAL ACID; (b) maintaining the membrane in contact with the acid at an ELEVATED TEMPERATURE for a period sufficient to produce a membrane having a water flux of at least about 8 gfd and a $MgSO_4$ rejection of at least about 65 percent when tested under reverse osmosis conditions at 50 psi and 25° C. using an aqueous solution of 0.2 weight percent $MgSO_4$; ...	(c) contacting the membrane from step (b) with a REJECTION ENHANCING AGENT so as to produce a membrane having a $MgSO_4$ rejection of at least about 85 percent.

Strong mineral acids are liquid at the applicable temperatures. In contrast, organic sulfonic acids are for the most part solids or crystalline at such temperatures, as discussed above in connection with the Chau et al. reference. Consequently with respect to the present invention, the Koo et al. reference is meaningless for alleged combination with Cadotte et al. in the manner contended by the Examiner, since Koo et al. in their description of "strong acids" make no distinction between solid and liquid phases for the acids. One cannot make a Cadotte et al. membrane with a solid or crystalline organic acid under Cadotte et al's reaction conditions, no matter how "strong" the organic acid is

labeled. Cadotte et al. understood this and clearly taught *only* mineral acids. They did not intend that organic acids were to be considered interchangeable, regardless of whether or not "strong," since phase is considerably more critical than strength in Cadotte et al's system.

Further, while It is true that Koo et al. does mention methanesulfonic (MSA), ethanesulfonic acid (ESA) and benzenesulfonic acid (BSA) as "strong" acids, and that these are within the scope of the amended claims in the present case. However, Koo et al. also mentions toluenesulfonic acid and camphorsulfonic acid as well as an undefined group of "other aromatic, aliphatic and cycloaliphatic sulfonic acids," of which most will be solids under the relevant conditions. This disclosure by Koo et al. can have no relevance to the amended claims since it does not differentiate between liquid and solid or crystalline sulfonic acids. For the Examiner to continue to maintain the Koo et al. reference in combination with Cadotte et al as to the amended claims would indeed be hindsight based solely on Applicant's disclosure, since neither Koo et al. nor any other reference of record teaches the significance of phase difference with respect to Applicant's invention.

Also, it is most important to recognize, as Applicant pointed out in his earlier response, the Koo et al. do not work with an organic sulfonic acid directly but rather work with amine salts of sulfonic acids. Not only are the amine salts not "strong acids," they are in fact neutral compounds. Koo et al. place their organic sulfonic acid directly into the aqueous solution from which the membrane is produced. In that solution the sulfonic acid undergoes reaction to a "salt-containing product" (col. 5, lines 20-24) and loses its identity as a sulfonic acid. The neutral salt also remains in the aqueous phase, and does not migrate into the solvent phase in which the membrane is formed. The function of the salt is not clear from Koo et al.; the patentees merely speculate that the salt may have some pore forming function (col. 5, lines 37-43). However, as to treating an already-formed membrane with an acid of any type, mineral or organic, Koo et al. teaches nothing, since no acid is present for treating because all have previously been converted to neutral salts in the Koo et al. system. Koo et al's chemistry requires removal of the organic sulfonic

acid *prior to* membrane formation by reaction to a neutral salt -- Cadotte et al's chemistry requires contacting of the membrane *after* formation with the mineral acid. Thus while one may understand from general chemistry, as the Examiner contends, that both mineral acids and sulfonic acids may for some purposes both be considered to be "strong acids," such understanding is of no significance with respect to the Applicant's invention. For the relevant comparison with Cadotte et al's mineral acids, *Koo et al. use only neutral amine salts*. Thus the Examiner's assertion of general chemistry principles in support of the rejection is not well taken, since Koo et al's mention of sulfonic acids is in a context completely unrelated to Cadotte et al's use of mineral acids or Applicant's use of the C₁-C₆ sulfonic acids.

The Examiner has contended that the method of production of Applicant's membranes are not properly an element of Applicant's Claims 15-26 with respect to the Cadotte et al. reference, citing similar final operating parameters of both Applicant's and Cadotte et al's membranes. That is not true as to the amended claims. As Table 2 on the next page indicates, the use of the low molecular weight sulfonic acids as defined in the amended claims permits production conditions which allow Applicant's membranes to be equal to or better than Cadotte et al's with far less processing -- i.e., with no need for "rejection enhancement."

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TABLE 2
Preferred Example Comparison of Cadotte et al. '897
and Tomaschke Application S/N '883

Patent	Example	Membrane ¹	Acid	Treatment Conditions	Rejection Enhancement	Flux Rejection (gfd) (%)	F/SP ²
Cadotte '897	12-15 average	FT-30 polyamide	85% Phosphoric	120° C 15 min.	300 ppm Tannic acid pH2 100 psi 15 min. Aqueous Hydrochloric acid pH3 High Flow/Low Pressure 5-20 min.	26.6 94.38	4.73
S/N '883	16	ESPA polyamide	10% Methane-sulfonic	Ambient 30 second 80° C 1 min. 20 seconds	None	25.5 98.37	15.6

Notes:

¹ These are proprietary polyamide membranes covered in US Patent Nos. 4,227,344 and 5,576,057, respectively.

² F/SP = Flux/Salt Passage, wherein Salt Passage = 100- Rejection. This is a membrane performance ranking expression. Test Conditions: 2000 ppm Magnesium sulfate at 60 psi pressure.

The Examiner has recognized that Cadotte et al. do not use organic acids. As a result in order to get the same results as Applicant they must resort to the second processing step of "rejection enhancement." Thus the key difference in Applicant's claims in the C₁-C₆ sulfonic acid inclusion, which is not present in the Cadotte et al. reference. Thus the systems can be compared and distinguished by their different acids, which implies the different processing conditions, and which would be well understood by those skilled in the art to make Applicant's membranes entirely unobvious from Cadotte et al's teaching, notwithstanding that they both end up with similar performance properties. In short, Cadotte et al. teach that the only way to obtain such membrane properties is to use mineral acids in a complex multi-step manufacturing process. Those skilled in the art would only learn from Cadotte et al. that if the acid step alone were used, the desired

membrane properties would not result.

On the other hand, Applicant's has uniquely discovered that if low molecular weight organic sulfonic acids are used, membranes of equivalent properties to Cadotte et al's can be obtained in a much simpler manufacturing process. Thus the distinguishing feature of the membrane claims, and which makes Applicant's claimed membranes clearly unobvious as defined in the amended claims, is the inclusion in the claims of the organic sulfonic acid contact which is not present in nor taught by nor suggested by Cadotte et al., which require mineral acids.

The Examiner has tried to overcome this fatal deficiency of Cadotte et al. by reliance upon Koo et al. in the manner discussed above. Since, however, it is clear that Koo et al. is not a valid reference for teaching of the criticality of the presently claimed low molecular weight organic sulfonic acids, nor for teaching of any equivalence of "strong" organic acids with "strong" mineral acids *in the context of the amended claims*, the critical distinctions evident from Table 2 above clearly establish that those amended claims are not made obvious under § 103(a) by any interpretation of a combination of Cadotte et al. with Koo et al.

FEES

It is not believed that any fees are due with respect to the amendment of the claims herein. However, should any such fees be due, the Patent and Trademark Office is authorized to charge all such fees to Deposit Account No. 02-4070.

CONCLUSION

In view of the above amendments and remarks, it is respectfully submitted that all grounds of rejection have been avoided and/or traversed. The Examiner is therefore respectfully requested to enter the amendments herein, reconsider and withdraw the rejections and allow Claims 15-26, as amended, all claims in the case following amendment and compliance with the restriction requirement.

Should the Examiner believe that prosecution of this application might be expedited by further discussion of the issues, a telephone call to the undersigned attorney, collect, at the telephone number listed below, is cordially invited.

Respectfully submitted,

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